CASE REPORT
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EVALUATION OF ELECTROCARDIOGRAPHIC CHANGES ASSOCIATED WITH HYPERKALEMIA IN A CAT AND ITS MANAGEMENT

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ABSTRACT

Hyperkalemia is a life-threatening electrolyte imbalance which influences cardiac conduction and may lead to fatal arrhythmias if left untreated. The present case report describes the electrocardiographic changes associated with hyperkalemia secondary to obstructive uropathy and cystitis in a cat. Atrial standstill and sino-ventricular rhythm, characterized by the absence of P waves on the electrocardiogram, were observed. Management of hyperkalemia was done using intravenous sodium bicarbonate and dextrose, along with treatment of the primary condition. Re-evaluation of the electrolyte levels and electrocardiogram after treatment revealed a reduction in the serum potassium level and normal sinus rhythm.

Keywords: Hyperkalemia, Hypocalcemia, Atrial standstill, Sino-ventricular rhythm

INTRODUCTION

Electrolyte imbalances are commonly encountered in cats, especially in those presented to critical care units. A multivariable analysis reported that electrolyte imbalances were linked with a higher mortality rate in cats. Measurement of electrolytes is important in the management of critically ill feline cases (Goggs *et al.*, 2018). Urinary disorders were found to be the most common cause of moderate to severe hyperkalemia in cats (Hoehne *et al.,* 2019). Hyperkalemia influences cardiac conduction and can result in fatal arrhythmias. Electrocardiography is a rapid, non-invasive and the diagnostic tool of choice for the detection of cardiac arrhythmias, and should be performed in

cats suspected for potassium imbalances.

CASE HISTORY AND OBSERVATION

A one-year-old, male intact, Persian cat was presented to the critical care unit of the Teaching Veterinary Clinical Complex, Pookode, with the complaint of anorexia, stranguria and oliguria for two days. On clinical examination, the cat was obtunded, severely dehydrated and hypothermic, with a rectal temperature of 98°F. The conjunctival mucous membranes were congested. Heart rate was 176 beats per minute. Abdominal palpation revealed a distended and turgid urinary bladder. On abdominal ultrasonography, the distended urinary bladder, with hyperechoic sediments inside the bladder, were observed. Serum biochemical evaluation revealed elevated levels of creatinine (14.49 mg/dL) and blood urea nitrogen (143.64 mg/dL). Serum electrolyte and mineral evaluation revealed severe hyperkalemia (serum potassium level – 8.1 mEq/L), hyponatremia (serum sodium level – 135.58 mEq/L) and hypocalcemia (serum total calcium level – 5.69 mg/dL). Based on the anamnesis and findings of physical examination and abdominal ultrasonography, the cat was diagnosed with obstructive uropathy and cystitis with secondary hyperkalemia, hyponatremia and hypocalcemia.

Electrocardiography was performed by positioning the cat in right lateral recumbency on a rubber coated foam mat, using minimally traumatic ECG clips. The recordings were taken using standard bipolar limb leads, augmented unipolar limb leads and precordial chest leads at paper speeds, 25 mm/sec and 50 mm/sec and voltage 10 mm/mV. The ECG revealed the absence of P waves, increased duration of QRS complexes and peaked T waves. Sino-ventricular rhythm with atrial standstill was observed (Fig. 1).

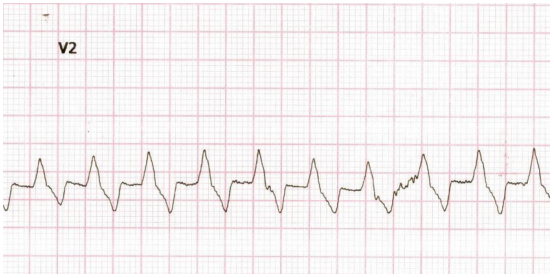

Fig.1 – ECG showing atrial standstill and sino-ventricular rhythm characterized by the absence of P waves and increased duration of QRS complexes, along with peaked T waves (Paper speed – 25 mm/sec, voltage – 10 mm/mV)

TREATMENT AND DISCUSSIONS

The cat was catheterized using a tom catheter to relieve the urine. Intravenous fluid therapy was initiated with normal saline solution to correct the dehydration. Hyperkalemia was corrected using five per cent sodium bicarbonate solution @ 2 mEq per kg body weight intravenously and 25 per cent dextrose @ 1 gm per kg body weight intravenously (Riordan and Schaer, 2015).

Serum electrolytes and electrocardiogram (ECG) were re-evaluated 12 hours after the initial treatment. At this point, serum potassium value had reduced to 6.2mEq/L, which indicated mild hyperkalemia. The presence of P waves, normal QRS duration and T wave amplitude were observed on the ECG. The ECG rhythm was consistent with normal sinus rhythm (Fig. 2). Fluid therapy and supportive treatment for obstructive uropathy and cystitis was continued for the next one week. Meloxicam @ 0.1 mg per kg body weight was given subcutaneously as an analgesic and anti-inflammatory. Oral glycosaminoglycan supplements were continued for two weeks, for maintaining bladder wall integrity.

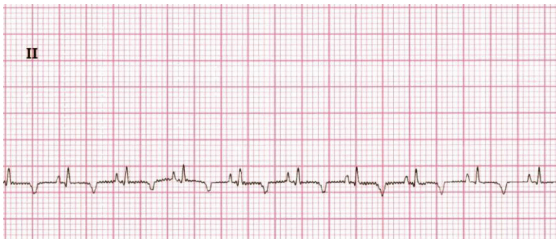

Fig.2 –ECG after correction of hyperkalemia, showing normal sinus rhythm
(Paper speed – 25 mm/sec, voltage – 10 mm/mV)

Electrocardiographic changes due to hyperkalemia have been previously studied in humans, dogs and cats, which included increase in the T wave amplitude, reduced R wave amplitude, depression of the ST segment and prolongation of the QRS complex and PR interval (Tag and Day, 2008). The atrial myocytes are more sensitive to the effects of hyperkalemia, when compared to the specialized pacemaker cells of the sino-atrial node (SA node) and atrio-ventricular node (AV node). The amplitude of the P wave on the ECG gradually decreases, leading to a complete loss of P waves which is described as atrial standstill. The resulting rhythm is termed as a 'sino-ventricular rhythm' as it arises in the SA node and is conducted to the AV node along the inter-nodal pathways, and then to the ventricles, without causing activation of the atria. This can progress to ventricular fibrillation and asystole if left untreated. Previous studies have reported the occurrence of atrial standstill and sino-ventricular rhythm in cats with hyperkalemia (Norman *et al.,* 2006; Hall *et al.,* 2010 and Spalla *et al.,* 2014). Intravenous dextrose administration leads to the endogenous release of insulin and intravenous sodium bicarbonate increases the extracellular pH, both of which lead to the intracellular translocation of potassium (Riordan and Schaer, 2015).

CONCLUSION

Evaluation of electrolytes is crucial in cats presented to the emergency room, especially those with upper or lower urinary tract disorders. Hyperkalemia is a life-threatening electrolyte abnormality as it affects cardiac conduction and can cause arrhythmias like atrial standstill and sino-ventricular rhythm, ultimately leading

to ventricular asystole, if left untreated. Electrocardiography should always be performed in cases suspected for electrolyte imbalances, particularly hyperkalemia, to identify any fatal arrhythmias and initiate treatment at the earliest.

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